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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/096,858	06/12/98	NARWANKAR	P AMAT2571.US/

PATENT COUNSEL MS 2061
LEGAL AFFAIRS DEPT
APPLIED MATERIALS INC
BOX 450A
SANTA CLARA CA 95052

MM12/1028

EXAMINER MAI, A

ART UNIT 2814	PAPER NUMBER 6
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DATE MAILED:

10/28/99

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/096,858

Applicant(s)

NARWANKAR ET AL.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Status

- 1) ☒ Responsive to communication(s) filed on 12 June 1998.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-45 is/are pending in the application.
- 4a) Of the above claim(s) 33-45 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some * c) ☐ None of the CERTIFIED copies of the priority documents have been:
1. ☐ received.
2. ☐ received in Application No. (Series Code / Serial Number) _____.
3. ☐ received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. & 119(e).

Attachment(s)

- 14) ☒ Notice of References Cited (PTO-892)
- 15) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 16) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 17) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 18) ☐ Notice of Informal Patent Application (PTO-152)
- 19) ☐ Other: _____

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DETAILED ACTION

Specification

1. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.
2. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the limitation, of claim 32, the dielectric layer is anneal in a chamber other than the deposition chamber have not supported by the specification.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

3. Claims 1, 2, 4-12, 14, 15, 17 and 21-23 are rejected under 35 U.S.C. 102(b) as being anticipated by Carl et al. (U.S. Patent No. 5,468,687).

With respect to claims 1, 8 and 14, Carl et al. teaches a method of annealing a dielectric layer as claimed including:

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forming a dielectric layer on a substrate;
generating an active atomic species in a first chamber; and
exposing the dielectric layer to the active atomic species wherein the substrate is located in a second chamber separate from the first chamber while exposing the dielectric layer to the active atomic species. (See col. 2, ll. 29-55).

With respect to claims 2, 9 and 17, the active atomic species of Carl comprises oxygen.

With respect to claims 4-6, 10-12 and 21-23, the dielectric layer of Carl comprises tantalum pentaoxide.

With respect to claims 7 and 15, the heating temperature of the dielectric layer of Carl is at the claimed range, however, no criticality has been established.

4. Claims 1-15, 17, 18 and 20-23 are rejected under 35 U.S.C. 102(e) as being anticipated by Hasegawa (U.S. Patent No. 5,677,015).

With respect to claims 1, 8 and 14, Hasegawa teaches a method of annealing a dielectric layer as claimed including:

forming a dielectric layer on a substrate;
generating an active atomic species in a first chamber; and

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exposing the dielectric layer to the active atomic species wherein the substrate is located in a second chamber separate from the first chamber while exposing the dielectric layer to the active atomic species. (See col. , ll. 29-55).

With respect to claims 2, 9 and 17, the active atomic species of Hasegawa comprises oxygen.

With respect to claims 3 and 18, the active atomic species of Hasegawa comprises nitrogen.

With respect to claims 4-6, 10-12 and 21-23, the dielectric layer of Hasegawa comprises tantalum pentaoxide.

With respect to claims 7 and 15, the heating temperature of the dielectric layer of Hasegawa is at the higher end of the claimed range, however, no criticality has been established.

With respect to claims 13 and 20, silicon oxide one of the dielectric layer of Hasegawa.

Hasegawa teaches a method of forming a capacitor as claimed including:
forming a bottom electrode (20);
depositing a transition metal dielectric (22) on the bottom electrode in a deposition chamber;

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generating reactive oxygen atoms by forming a plasma from an oxygen-containing gas;

annealing the transition metal dielectric by exposing the transition metal dielectric to the reactive oxygen atoms, wherein the annealing step occurs in a chamber separate from the plasma generation chamber; and

forming a top electrode on the reactive oxygen atoms exposed transition metal dielectric. (See example 4, col. 6, l. 31-col. 7, l. 17 and example 6, col. 8, l. 1-col. 9, l. 13).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 3, 13, 18 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carl et al., as applied to claims 1, 8 and 14 above, and further in view of In view of Hasegawa.

Carl teaches a method as described supra but fails to use nitrogen as an active atomic species and silicon oxide as the dielectric layer.

However, Hasegawa, in a similar method of annealing the dielectric layer, teaches using nitrogen as an active atomic species to anneal the dielectric layer.

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It would have been obvious to one having ordinary skill in the art at the time of the invention to use nitrogen species to anneal the dielectric layer of Carl as taught by Hasegawa to improve the specific dielectric constant of the dielectric layer.

Further, silicon oxide is also used by Hasegawa to compare the specific dielectric constant to the transition metal dielectric.

It would have been obvious to one having ordinary skill in the art at the time of the invention to use silicon oxide in place of the dielectric layer of Carl as taught by Hasegawa if the lower specific dielectric constant is desired.

6. Claims 16 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Carl, in view of Hasegawa, as applied to claim 14 above, and further in view of Slomowitz. (U.S. Patent No. 4,888,088).

Carl, in view of Hasegawa, teaches a method as described supra but fails to disclose generating plasma from a microwave applicator cavity.

However, Slomowitz, in a method of forming remote plasma, teaches generating plasma from a remote microwave applicator cavity (10). (See Fig. 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to generate plasma of Carl from the remote microwave applicator cavity as taught by Slomowitz to avoid any deterioration of the ignitor by the gases used for plasma.

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7. Claims 16 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa as applied to claim 14 above, and further in view of Slomowitz.

Hasegawa teaches a method as described supra but fails to disclose generating plasma from a microwave applicator cavity.

However, Slomowitz, a method of forming remote plasma, teaches generating plasma from a remote microwave applicator cavity (10). (See Fig. 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to generate plasma of Hasegawa from the remote microwave applicator cavity as taught by Slomowitz to avoid any deterioration of the ignitor by the gases used for plasma.

8. Claims 24-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa in view of Slomowitz.

Hasegawa teaches a method of forming a capacitor as claimed including:

forming a bottom electrode (20);

depositing a transition metal dielectric (22) on the bottom electrode in a deposition chamber;

generating reactive oxygen atoms by forming a plasma from an oxygen-containing gas;

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annealing the transition metal dielectric by exposing the transition metal dielectric to the reactive oxygen atoms, wherein the annealing step occurs in a chamber separate from the plasma generation chamber; and

forming a top electrode on the reactive oxygen atoms exposed transition metal dielectric. (See example 4, col. 6, l. 31-col. 7, l. 17 and example 6, col. 8, l. 1-col. 9, l. 13).

Hasegawa fails to disclose generating plasma from a microwave applicator cavity.

However, Slomowitz, a method of forming remote plasma, teaches generating plasma from a remote microwave applicator cavity (10). (See Fig. 1).

It would have been obvious to one having ordinary skill in the art at the time of the invention to generate plasma of Hasegawa from the remote microwave applicator cavity as taught by Slomowitz to avoid any deterioration of the ignitor by the gases used for plasma.

With respect to claims 25-27 and 29, the source gases are covered by Hasegawa.

With respect to claim 28, the deposition temperature is disclosed by Hasegawa.

With respect to claim 30, the transition metal dielectric film of Hasegawa is annealed in the deposition chamber.

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With respect to claim 31, the heating temperature of the transition metal dielectric layer of Hasegawa is at the higher end of the claimed range, however, no criticality has been established.

9. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hasegawa, in view of Slomowitz, as applied to claim 24 above, and further in view of Green et al. (U.S. Patent No. 5,814,562).

Hasegawa, in view of Slomowitz, teaches a method as described supra but fails to anneal the transition metal dielectric in a chamber other than the deposition chamber.

However, Green, in a process for semiconductor device fabrication, discloses a multi-chamber processing tool wherein the substrate can be transfer from one chamber to the next without being exposed to oxygen.

It would have been obvious to one having ordinary skill in the art at the time of the invention to anneal the transition metal dielectric layer of Hasegawa using a multi-chamber processing tool as taught by Green because each chamber can be used for a specific task hence save time.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is 703-305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

A.M.

Anh D. Mai
October 19, 1999

Olik Chaudhuri
Olik Chaudhuri
Supervisory Patent Examiner
Technology Center 2800